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Figure 1. Spectra and calibration curves for biomarkers

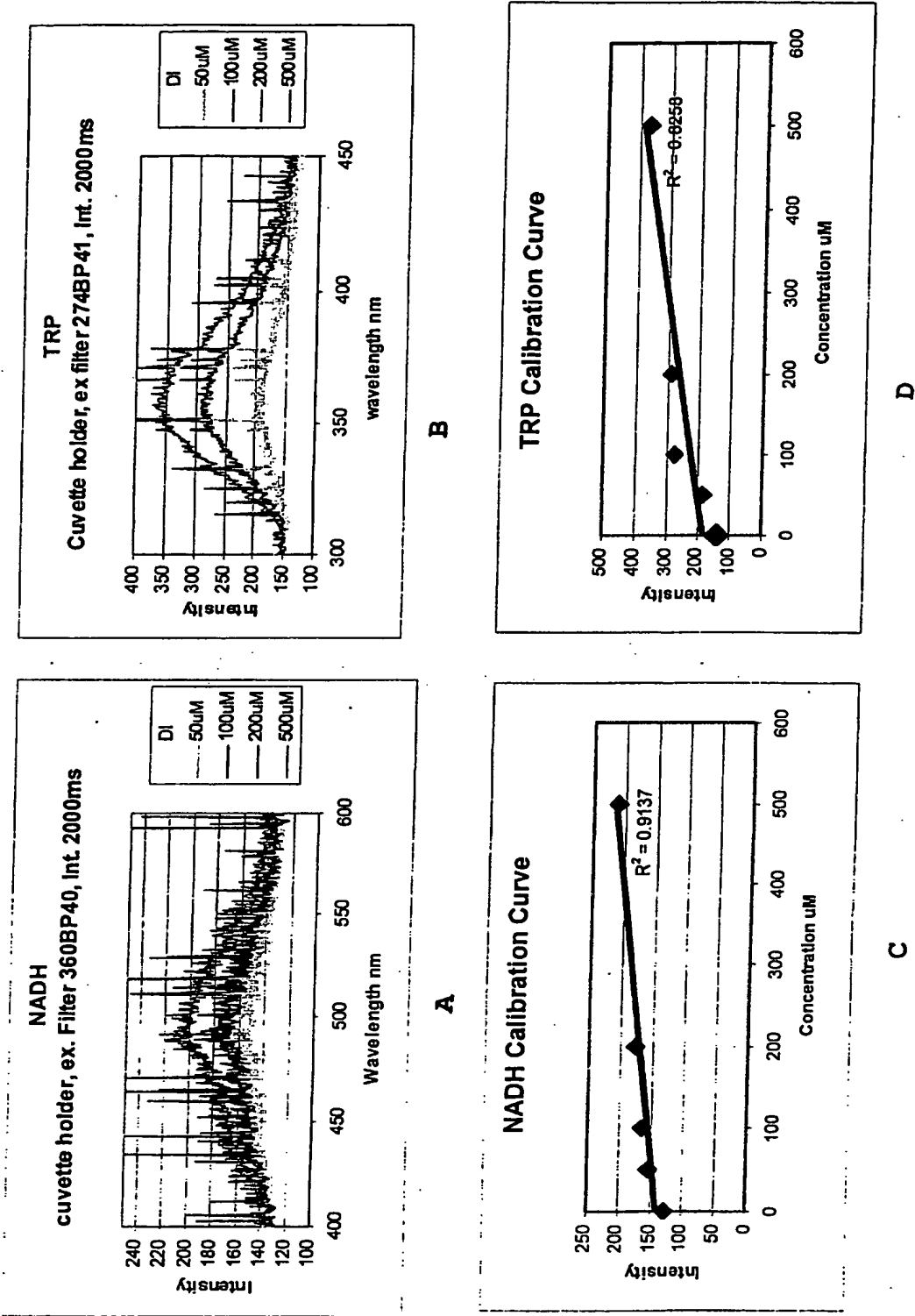
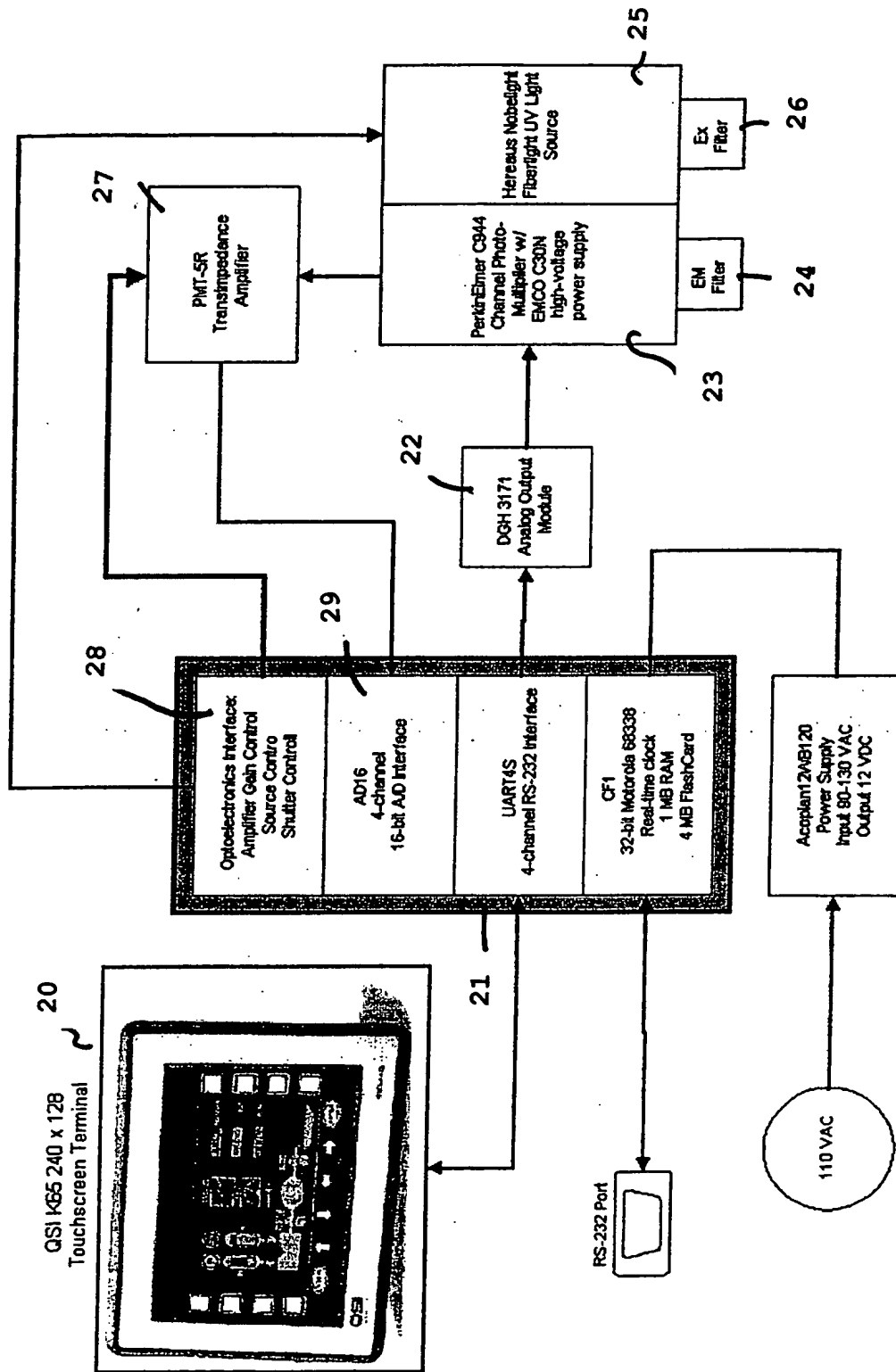


Figure 2. BLOCK DIAGRAM OF BIOFILM MONITORING SYSTEM

System Enclosure NEMA 4 (IP65)



PROPRIETARY

Figure 3. Direct Fluorescence Detection of Biofilms

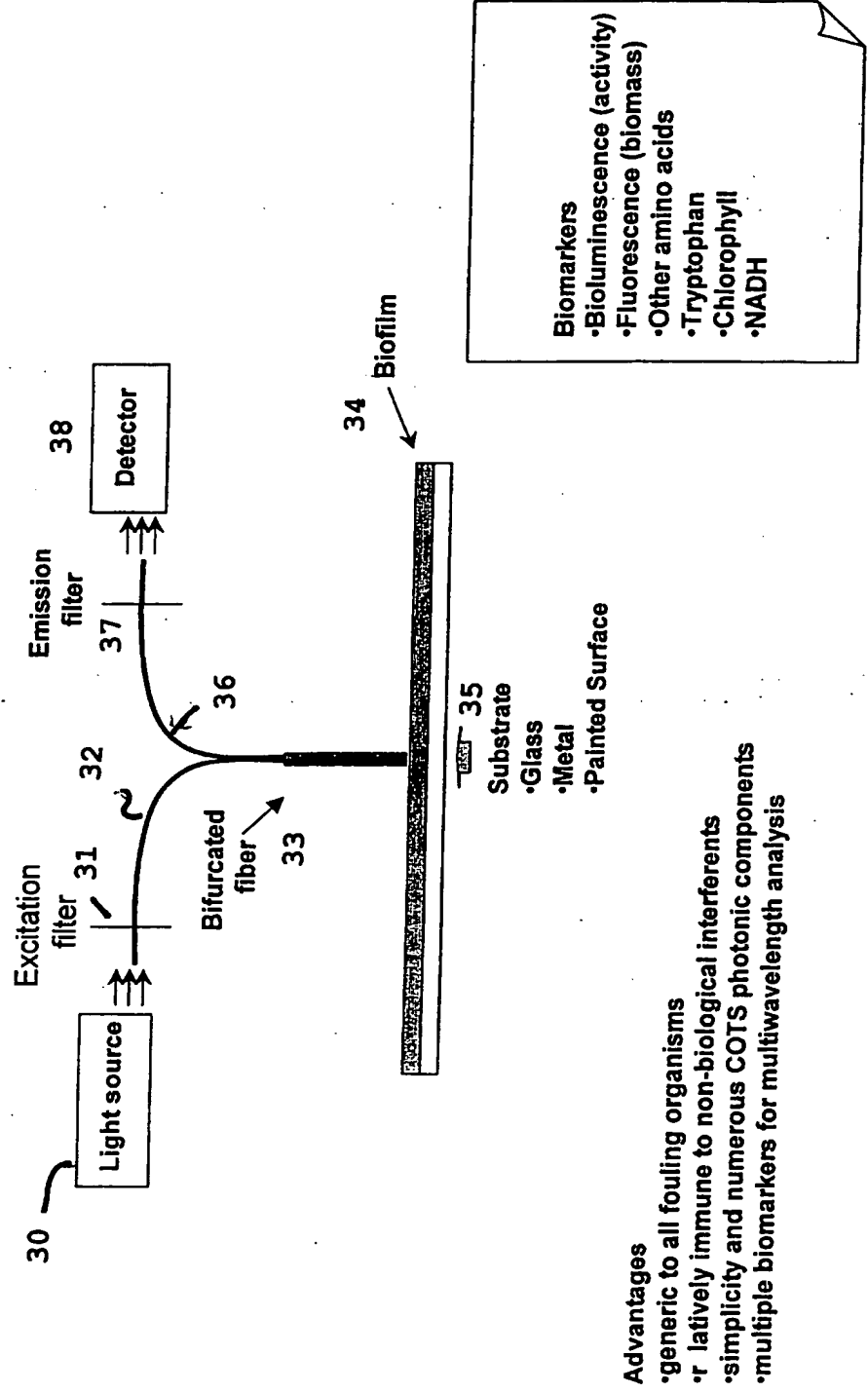


Figure 4. BMS monitoring of a *P.aeruginosa* biofilm over time

- readings taken directly on substrate
- signal increases as biofilm grows
- signal decreases when biocide applied or due to "sloughing off"

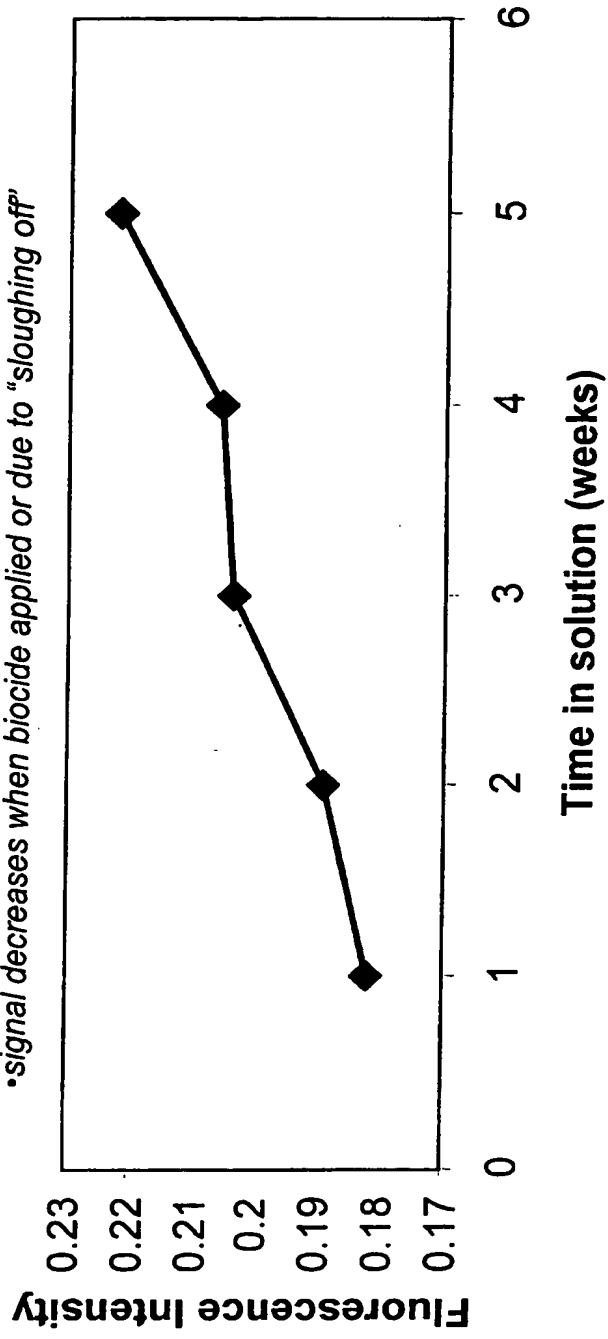


Figure 5. Optical signal as function of cell number

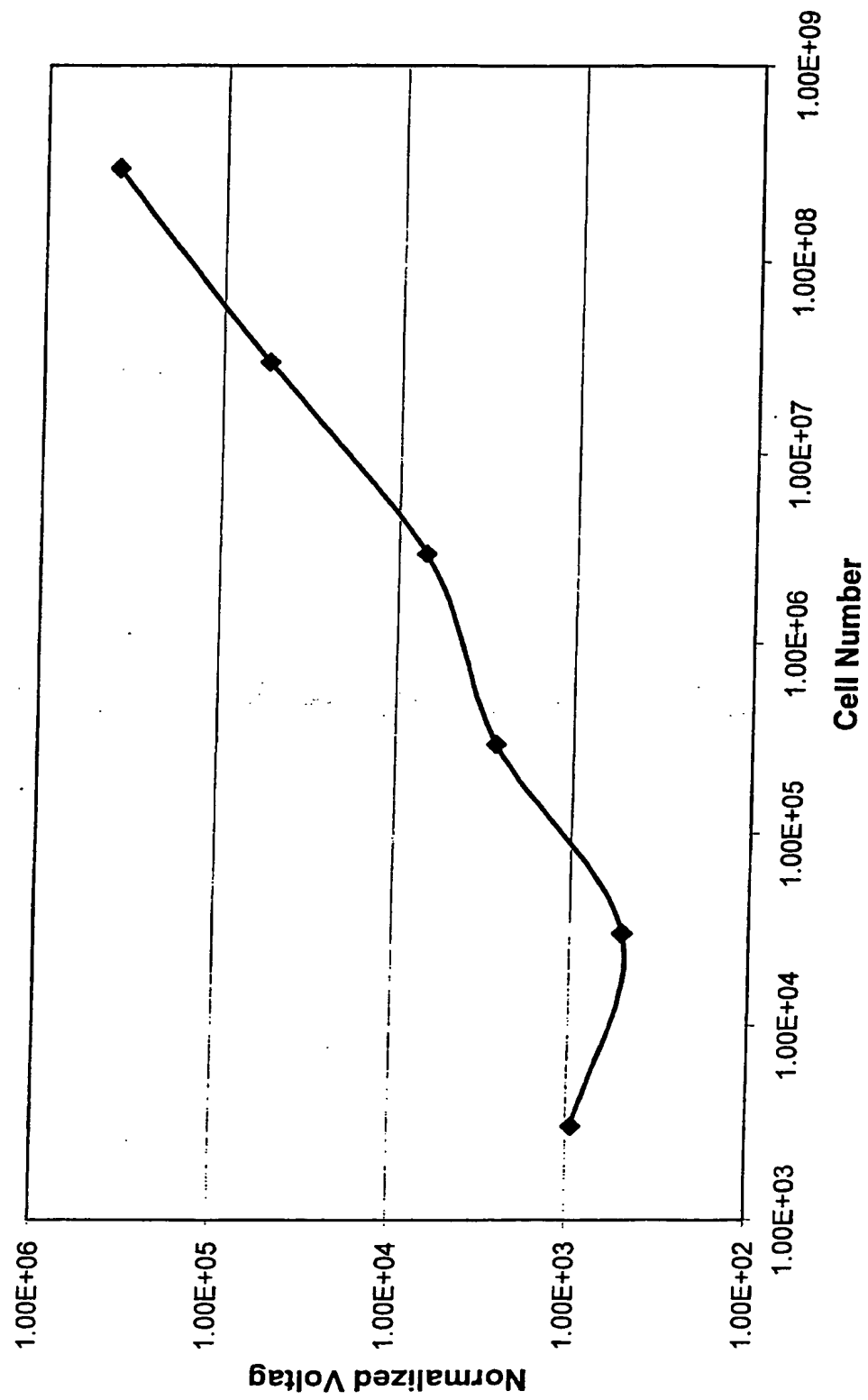


Figure 6. System detects all common fouling organisms

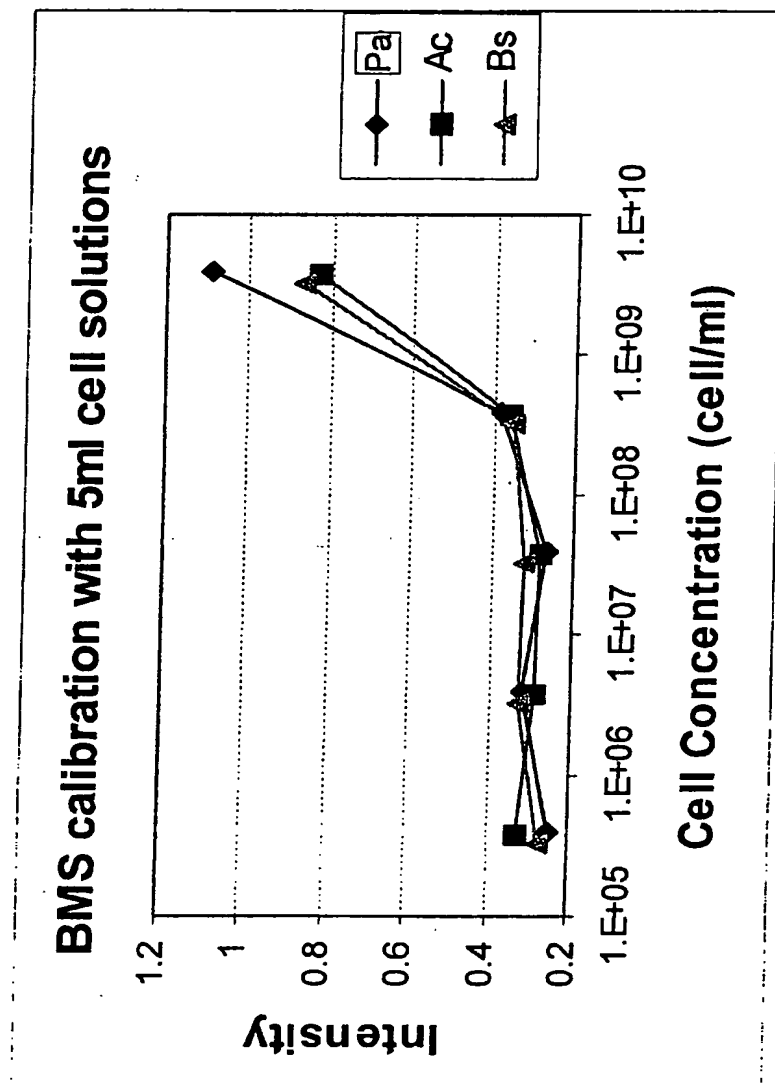


Figure 6. Calibration curves of the new BMS probe and test fixture using 3 bacterial solutions

Figure 7. Correlation of the signal with cell count

- signal correlates with cell count
- sensor tracks dynamic changes in real time
- signal decreases when biocide applied or due to "sloughing off"

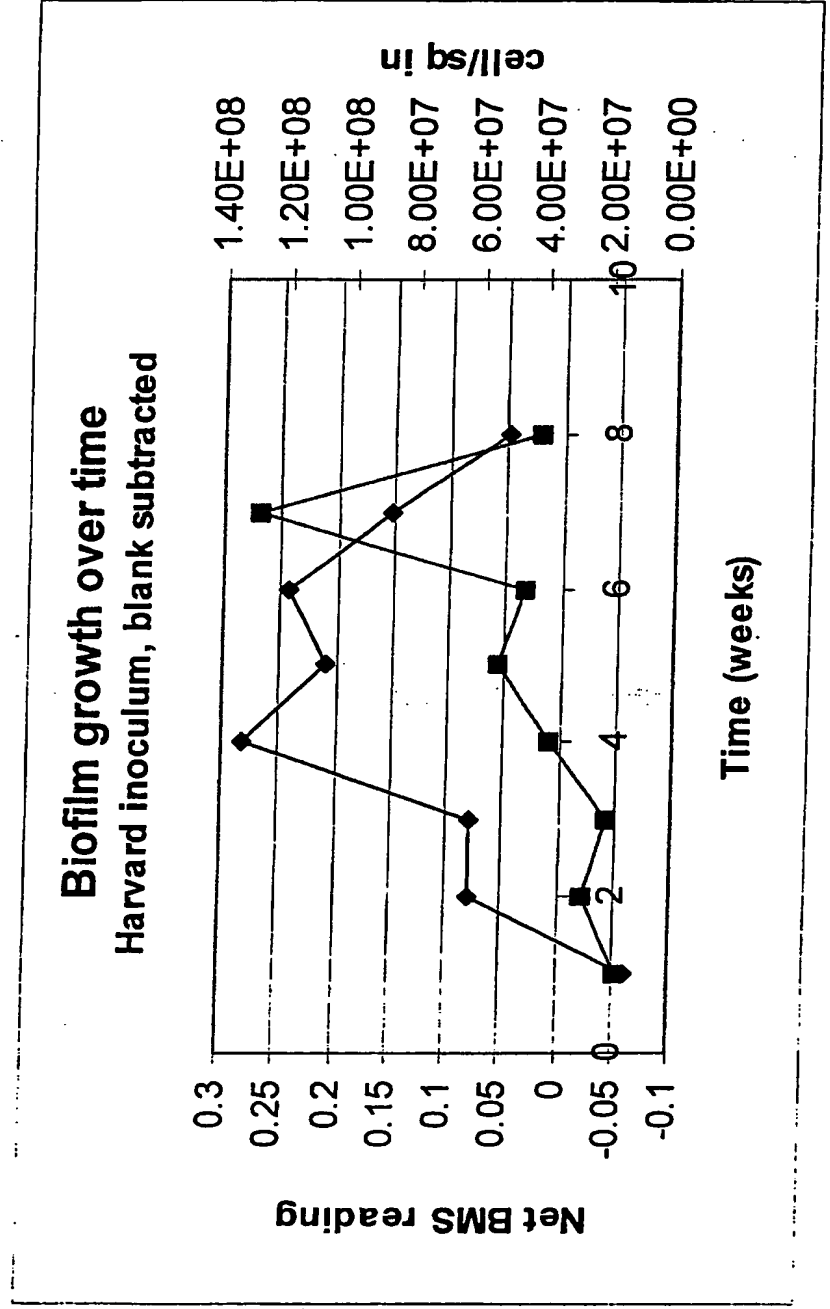


Figure 8. Multiple biomarkers allow discrimination from fluorescent interferents, e.g., common hydrocarbons

- Ar-HC's fluoresce at TRP λ
- no fluorescence at NADH λ_{ex}

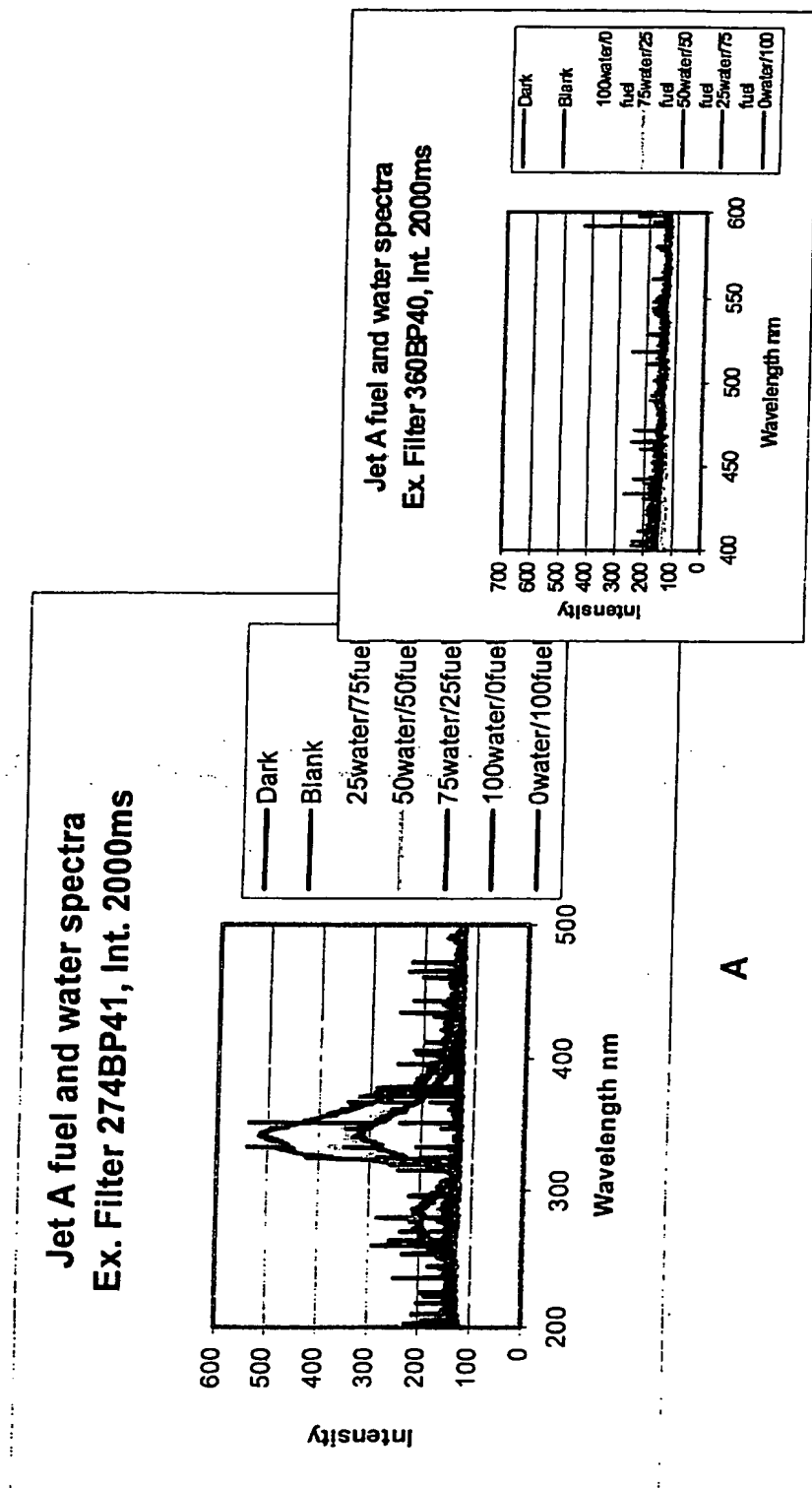


Figure 9. Block diagram for multi-channel biofilm monitoring system for use in process fluids

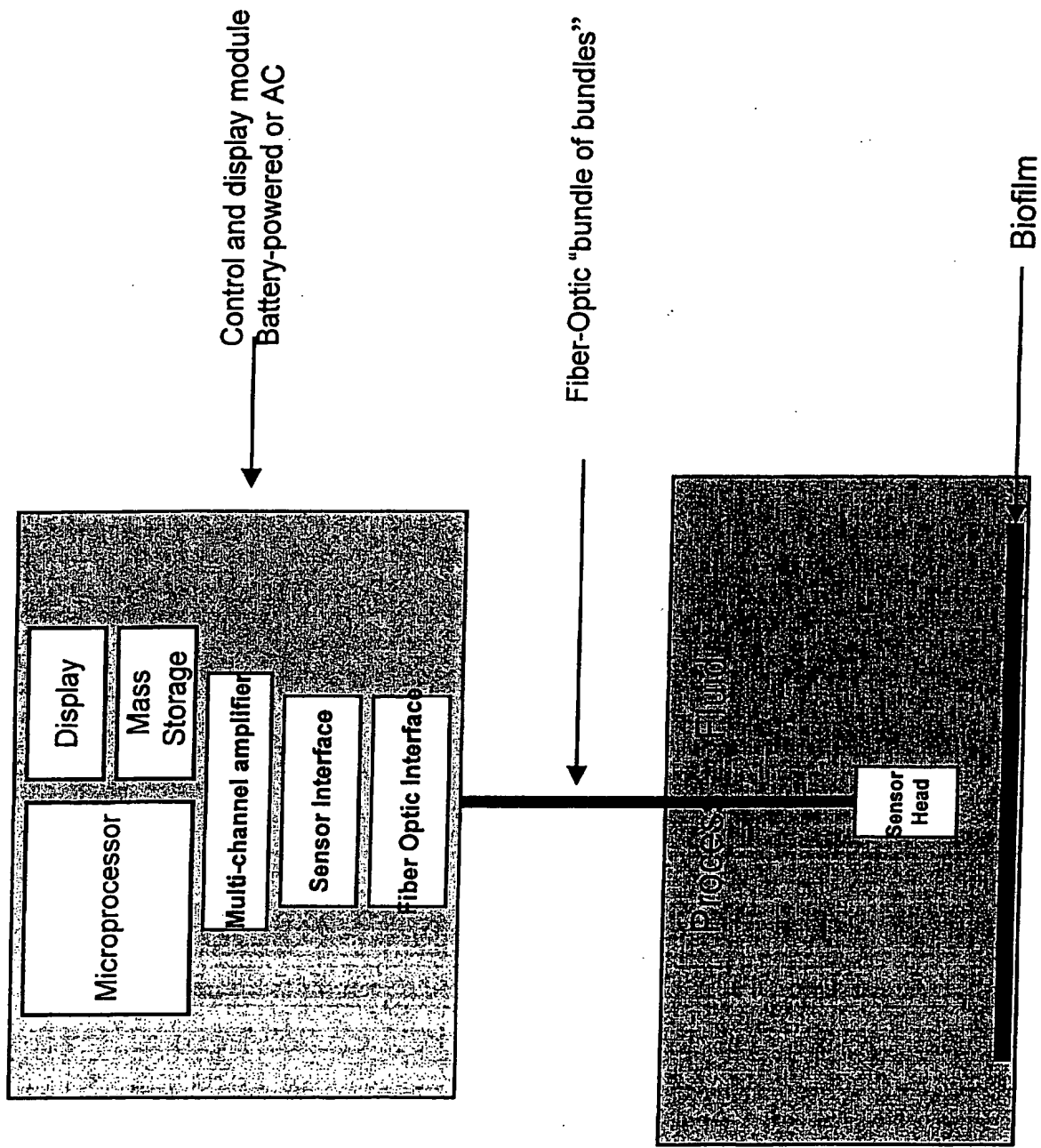
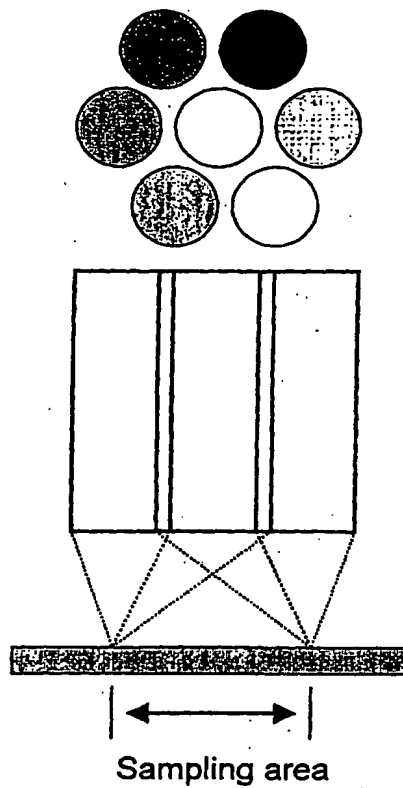


Figure 10. New fiber-optic probe design

- *probe is a "bundle of bundles"*
- *each bundles has 6 ex, 1 em fiber*



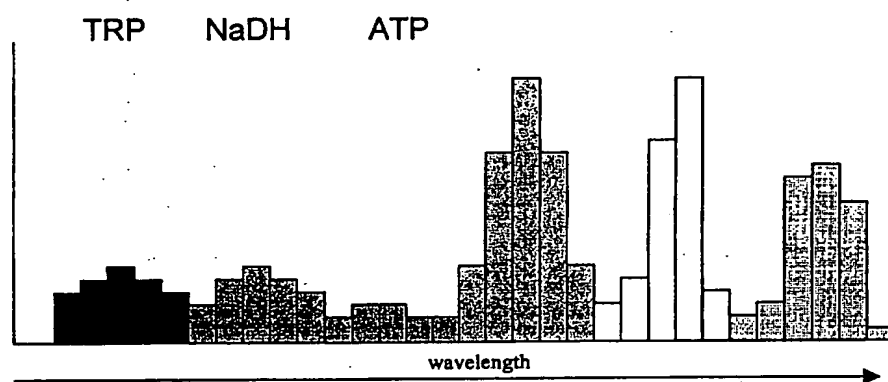
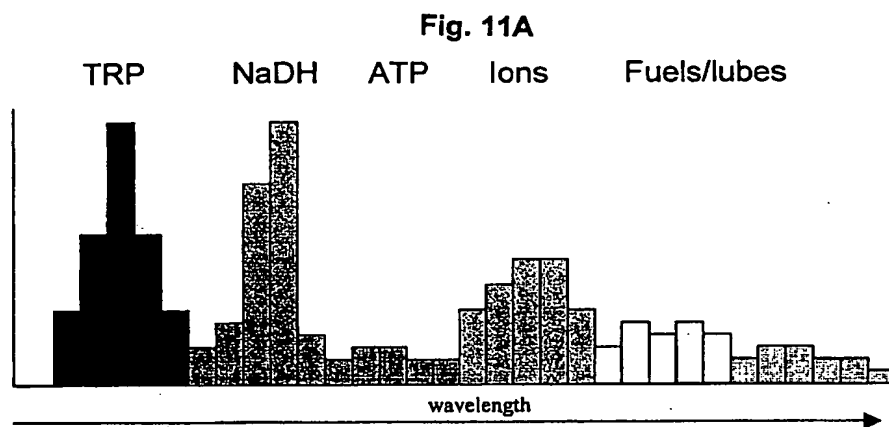


Fig. 11B
**32 channel spectrograph for monitoring
 signal from multiple biomarkers and potential interferents**

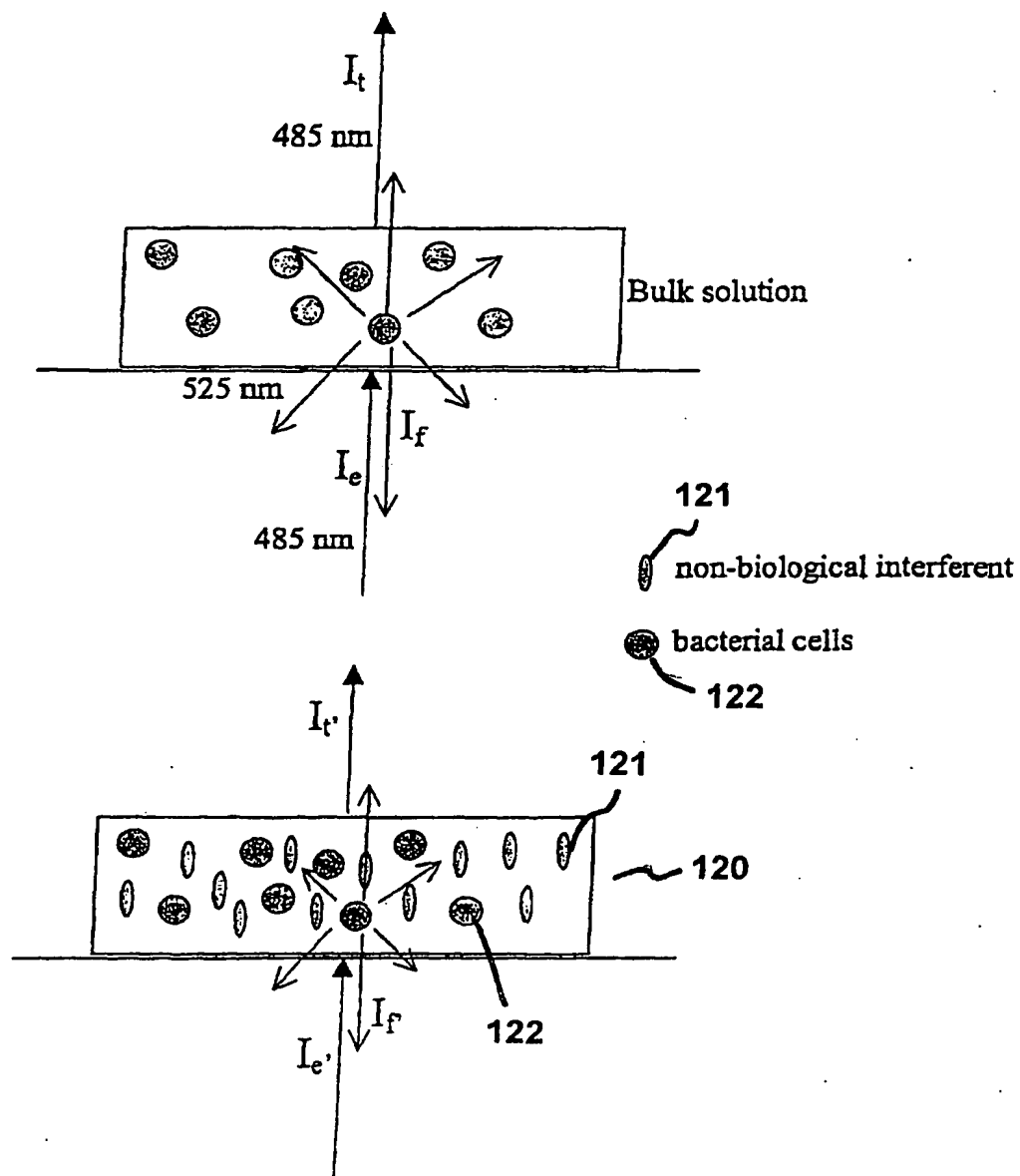


Figure 12. Concept using an excitation reference channel to correct for spectral interference from non-biological materials. Wavelengths are given as examples but can be any UV-VIS-NIR wavelengths.